



AN EXPLORATION OF PRIMARY SCHOOL TEACHERS' MATHS ANXIETY USING INTERPRETATIVE PHENOMENOLOGICAL ANALYSIS

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Abstract

Primary school teachers are important in children's learning of mathematics, and maths anxiety development has been partly attributed to children's classroom experiences (Das & Das, 2013). Maths anxiety was explored in UK primary school teachers, with a view to understanding its development and impact. Data from four semi-structured individual interviews were analysed using Interpretative Phenomenological Analysis (IPA), which facilitates a deeper knowledge of individuals' personal experience. Three key themes emerged: "experiencing the psychological consequences of maths anxiety", "social influences" and "the consequences of experiencing maths anxiety as a teaching professional". The findings contribute to our understanding of the influence of maths anxiety on teachers and teaching practices.

Keywords: Maths anxiety, qualitative research, primary school teachers, experience of teaching.

INTRODUCTION

Maths anxiety is a negative emotional response to situations involving mathematics (henceforth maths); it is not simply a proxy for poor maths ability but rather the fear that arises in individuals undertaking a mathematical task, which impedes performance (Beilock, Gunderson, Ramirez, & Levine, 2010). Indeed, there is much evidence that maths anxiety is negatively related to maths performance (Hembree, 1990; Namkung, Peng, & Lin, 2019; Zhang, Zhao, & Kong, 2019; Barroso, Ganley, McGraw, Geer, Hart, & Daucourt, 2021). It is associated with avoidance of effort-based decision making (Choe, Jenifer, Rozek, Berman, & Beilock, 2019) and maths related education or career paths (Hembree, 1990; Ahmed, 2018). It can also have serious implications within the workplace such as inaccurate calculations of drug dosages by medical staff (Ahmed, Minnaert, Kuiper, & van der Werf, 2012) or impaired financial planning (Beilock & Willingham, 2014). People with maths anxiety may experience negative feelings when asked to divide up a restaurant bill or answer a mathematical problem in front of others. Fear of being judged or looking incompetent in front of others are the consequences of failure and can lead to unpleasant physiological reactions such as feelings of tension, nervousness or nausea (Dowker, Sarkar, & Looi, 2016).

It is difficult to determine the causes of maths anxiety. One argument is that some people have a genetic predisposition to develop maths anxiety. This has been seen in maths anxiety studies involving



twins. For example, Wang, Hart, Kovas, Lukowski, Soden, Thompson, Plomin, McLoughlin, Bartlett, Lyons, and Petrill (2014) studied 514 twelve-year-old twin pairs who were given a test to assess their maths anxiety levels, a general test of anxiety, a maths problem solving test and a reading comprehension test. A multivariate analysis revealed 40% of the variance in maths anxiety of the twin pairs was accounted for by behavioural genetic factors and the remaining variance explained by non-shared child-specific environmental factors. This suggests that maths anxiety may result from a combination of negative experiences with maths and predisposing genetic risk factors associated with maths cognition and general anxiety (Wang et al., 2014). Other work has suggested that brain activity is associated with maths anxiety, e.g. neuroimaging studies indicate individuals with high maths anxiety show reduced response in the posterior parietal and dorsolateral pre-frontal cortex brain regions (which are involved in mathematical cognition) and increased responses in the right amygdala – the brain region involved in affective fearfulness and threat detection (Young, Wu, & Menon, 2012).

Psychological theories have emphasised the role of cognitive processes, e.g. that working memory of individuals with high maths anxiety is impaired by intrusive, worrisome thoughts (Ashcraft & Krause, 2007). In particular, it is thought that high maths anxious individuals use up limited attentional resources of the central executive component of working memory, rather than allocating their attentional resources to the task at hand (Suárez-Pellicioni, Núñez-Peña, & Colomé, 2016). This debilitating effects model, however, has been discussed against a deficit model whereby an early deficit in mathematical understanding and knowledge is thought to lead to the later development of maths anxiety (Ma & Xu, 2004). As Carey, Hill, Devine and Szucs (2016) note, it is likely that a reciprocal model is more likely. It also seems that maths anxiety is strongly related to the way a person rates themselves in relation to maths (Dowker, Sarkar, & Looi, 2016).

It is likely that negative or positive reactions and experiences associated with maths will influence an individual's self-concept. Self-concept is a global composite view of oneself: how an individual perceives their skills and abilities they possess (Bong & Skaalvik, 2003). Self-efficacy, on the other hand, is concerned with what individuals believe they can do with the skills and abilities they possess (Bong & Skaalvik, 2003) and constitutes an individual's innate belief in their ability to succeed at a task or in a situation (Bandura, 1982). Emotional and psychological states contribute to an individual's self-efficacy towards their maths capabilities. Self-efficacy is influenced by an individual's past experience and their perceived ability to master, or not, a particular task. It is also influenced by seeing others who they determine to be similar to themselves either succeed or fail. Social encouragement from others also influences self-efficacy; however, positive encouragement is more difficult to impart and therefore to influence positive self-efficacy compared with the ease it takes to undermine an individual. Reducing the stress response and an individual's negative tendencies that they associate with a task or situation will also modify self-efficacy (Bandura, 1994): how an individual perceives themselves and their abilities influences their thoughts and behaviours towards a task or situation. A high self-concept in maths for example may lead an individual to have a positive outlook on maths and based on their feelings towards it and their past positive experiences may lead them to consider that they have good maths abilities. For these individuals any maths difficulties may be seen as challenges, thus prompting a positive approach towards solving problems. On the other hand, a low maths self-concept can lead to a focus on negative maths experiences and a low perception of one's maths ability, giving a negative overall view of maths and possibly prompting anxiety around it.

One of the most clearly investigated factors on maths anxiety is the relationship between gender and maths. Although research indicates that males and females provided equal education in maths show little or no difference in mathematical performance, females do tend to rate themselves lower in maths ability and to express more anxiety (Dowker, Sarkar, & Looi, 2016). This increased anxiety expression in females is posited to come from several sources such as exposure to gender stereotypes and the influence of and social transmission of anxiety by female teachers who are maths anxious (Beilock et al., 2010). Stereotypically the common assumption in the maths domain is that males are better at maths than females. When a relevant negative stereotype is made salient in a



performance situation an individual may perform more negatively than perhaps their ability would suggest, resulting in stereotype threat (Maloney, Schaeffer & Beilock, 2013); this can impact both maths anxious males who feel they are required to uphold the positive image of male maths superiority, and females who feel they confirm the negative stereotype.

Some researchers have suggested anxiety as resulting from a combination of factors: if a child has cognitive issues with numerical and spatial competencies and lacks confidence, they may have a greater predisposition to pick up the negative cues from their maths anxious teacher, leading to the development of maths anxiety (Maloney & Beilock, 2012). Additionally, negative classroom experiences are considered by some researchers as key factors in the development of maths anxiety. This includes maths being taught in a rigid, non-participatory or rote fashion without full explanation of the concepts and procedures behind the methods (Das & Das, 2013) or an overreliance on using tests to assess maths learning as well as teacher attitudes (Hamza & Helal, 2013). Schofield (1981) found that teacher attitudes were linked to students' performance and attitudes towards maths. Teachers who were classified with low or middle levels of achievement and attitude in their own maths ability maintained the lowest student performance scores with students holding the least favourable attitudes towards maths. This was compared to teachers with high maths achievement and a positive maths attitude whose teaching produced high achieving students even though the students had initially had an unfavourable attitude towards maths. Jackson and Leffingwell (1999) also researched teachers' own attitudes towards maths as a subject and how their attitude towards teaching affected student performance. They found that many had negative early school years experiences, describing negative teacher behaviours, including hostility if they asked for help or highlighting student errors in front of the class, causing embarrassment and humiliation. Overall, their study suggested that just 7% of their sample reported having had only positive experiences with maths during their school years.

It is important to understand, therefore, how for some teachers a negative maths attitude might evolve. Teachers who are anxious about their own maths ability may unwittingly impart these negative beliefs to some of their students and therefore contribute to the development of the cycle of maths anxiety. A negative attitude towards maths may also lead teachers to reduce their effort, affecting their instructional behaviour, which in turn influences student attitudes. Relich, Way and Martin (1994) suggested that a positive teacher attitude towards maths is beneficial as it helps develop positive student attitudes; this then increases the likelihood of students investing more time and energy in improving their own competence.

A teacher's professional identity is a combination of their past experiences around maths, social influences such as maths gender stereotypes as well as their knowledge, maths self-efficacy and maths self-concept (Bennison & Goos, 2013). Research has shown that even teachers with high levels of maths anxiety hold high efficacious beliefs about their ability to teach maths and express confidence in their ability to be effective maths teachers (Swars, Daane, & Giesen, 2006). This may be due to the availability of professional learning and improved pedagogical maths content support for teachers that helps bolster their confidence in their ability to teach maths effectively.

Much of the research into maths anxiety seems to rely on questionnaires, beginning with the Mathematics Anxiety Rating Scale (Richardson & Suinn, 1972), and its subsequent versions (Plake & Parker, 1982; Alexander & Martray, 1989; Suinn & Winston, 2003). More recent scales have been developed or modified to measure maths anxiety in populations outside of the U.S.A. (e.g. Hunt, Clark-Carter, & Sheffield, 2011; Nunez-Pena, Suarez-Pellicioni, Guilera, & Mercade-Carranza, 2013). Questionnaires provide useful data about maths anxiety; however, such a measurement technique may not capture the full range of individuals' attitudes, feelings and experiences of maths.

To date, relatively few studies have adopted a qualitative methodology to investigate maths anxiety. Those that have, have tended to focus on pre-service teachers. Trujillo and Hadfield



(1999), via a series of interviews, identified commonalities between pre-service teachers in relation to their negative emotions relating to maths, including early school and home experiences and how they planned to overcome their maths anxiety. More recently, Uusimaki and Nason (2004) conducted mixed-methods research to investigate pre-service teachers' negative beliefs and anxiety around maths. Applying thematic analysis (Braun & Clarke, 2006) to interview data, they generated three 'school experiences' themes: '*origins of negative beliefs and anxiety about mathematics*', '*situations causing most maths anxiety*' and '*types of maths causing maths anxiety*'. They demonstrated that most of the pre-service teachers' maths anxiety could be attributed to their own primary school experiences in learning maths, such as within test situations, having to give verbal explanations, dealing with poor teacher attitudes and difficult mathematical content. In their quantitative element, Uusimaki and Nason (2004) ascertained the number of participants per theme and converted the totals to percentage scores. These findings suggested that 72% of their participants attributed their negative school maths experiences to their teachers, rather than to specific mathematical content or social factors such as family or peers. These findings have been supported more recently within work from Bekdemir (2010), who found pre-service teachers' maths anxiety to be related to their own remembered negative classroom experiences, in particular the perceived hostility and inadequacy of their teachers.

It seems, then, that teachers' own early negative experiences in learning maths might contribute to the development of anxiety towards maths in others. However, research has suggested that even if teachers experience maths anxiety and have a low aptitude for maths themselves, this does not preclude them from continuing their career as a teacher and successfully teaching maths nor does it negatively impact their confidence in their ability to teach maths (Beilock et al., 2010; Bennison & Goos, 2013). A qualitative approach, aimed at giving a deeper understanding of what it is like to experience maths anxiety, can be used to develop more applicable interventions and training as well as to help raise awareness of the impact of experiencing its potentially debilitating effects. Maths teachers in secondary education elect to specialise in maths and therefore, we suggest, may not exhibit as much maths anxiety as teachers in the primary education sector who are obliged to teach mathematics as part of the curriculum. To facilitate a more in-depth understanding, the present research utilizes the qualitative approach of Interpretative Phenomenological Analysis to explore primary school teachers' experiences and understanding of their own maths anxiety.

METHOD

Analytic Approach

Teachers' personal accounts, gained via semi-structured interviews, are analysed using Interpretative Phenomenological Analysis (IPA, Smith, Flowers, & Larkin, 2009). IPA has been developed through integrating ideas from philosophers such as Husserl, Heidegger, Merleau-Ponty, and Sartre (Smith, Flowers, & Larkin, 2009). Drawing on philosophical areas of phenomenology, hermeneutics and ideography, IPA goes beyond pure description of events exploring how individuals make sense of their experiences, such as maths anxiety, and what meanings they attach to them. For example, IPA can give a deeper understanding of the feelings, behavior and consequences of how a participant felt about being singled out when they were a child to answer a maths problem in front of a class.

IPA is fundamentally ideographic – researchers are committed to a detailed analysis of the phenomenon under investigation, analysing each individual's lived experience before moving to a cross-case analysis illuminating convergence and divergence between individuals (Tuffour, 2017). Teachers are the experts on their own maths anxiety experiences offering an 'insider's' perspective through accounts of their childhood maths encounters and the impact of those encounters on their professional lives as primary school teachers.

The data generated are embedded in the specific contextual and socio-cultural background that participants and researcher share (Reid, Flowers, & Larkin, 2005) and the analytic process of IPA



is a subjective and reflective process of interpretation by the researcher of the participants' experiences (Smith, Flowers, & Larkin, 2009). The researcher actively works with these data, balancing shared commonalities across each account and highlighting participants' experiences (Reid et al., 2005). It has been argued that IPA might become more descriptive than interpretative (Truffour, 2017) therefore it is important to acknowledge the double hermeneutic of the researcher interpreting the participants' interpretations of their experiences.

With its focus on lived experience IPA was deemed appropriate for an exploration of the experience of maths anxiety. This is a topic that individuals express their feelings towards – it is socially acceptable to 'admit' to not liking/not being good at maths (Kindermann & Skinner, 2009) – therefore participants are likely to share rich and detailed information about its impact on their lives. As discussed previously much of the research in this area has used quantitative approaches such as surveys and questionnaires whereas insights into the experience of anxiety about encounters with maths are limited. Taking this novel approach our overall aim was to explore the maths anxiety experiences of primary school teachers, offering a specific focus on increasing understanding of the psychological impact of maths anxiety on primary school teachers and their perception of its impact upon them.

Research Design

Data were generated using semi-structured interviews and then analysed using Interpretative Phenomenological Analysis (IPA). Rather than predicting what might prevent maths anxiety, IPA enables insight into how primary school teachers make sense of their own maths anxiety experiences thus informing recommendations for future developments of support in the area (Cooper, Fleischer, & Cotton, 2012).

Recruitment Strategy

Participants were recruited from a state-run mixed primary school (ages 7-11) based in a large town in the U.K. Permission was granted to advertise in the staff room for participants who believed they suffered with maths anxiety; thus the participant group all self-reported their maths anxiety. All participants consented to the study and were fully debriefed. Anonymity was guaranteed through the *use of pseudonyms in all transcripts and reporting*. *Ethical clearance was granted by the university research ethics board following guidelines from the British Psychological Society (BPS) Code of Human Research Ethics (2010).*

Participants

As guided within the methodological framework of IPA a small, purposive sample of primary school teachers (Table 1, four participants) was selected for inclusion. Their homogeneity (sharing similarities such as occupation and working environment) ensured that detailed accounts generated during the interview yielded sufficient relevant and idiographic information (Cooper, Fleischer, & Cotton, 2012). No age range or gender was specified.

Table 1. Participant details

| Participant pseudonym | Tania | Maria | John | Kate |
|-----------------------------|-------|-------|------|------|
| Participant age (years) | 29 | 28 | 38 | 21 |
| Number of years teaching | 10 | 7 | 2 | <1 |
| Ages of children they teach | 7-8 | 8-9 | 7-8 | 6-7 |

Being taught maths at school and additional maths education

Tania remembers learning multiplication tables by rote, being selected to answer a maths problem in front of the class and being sat at a desk with the teacher in the front of the class as well as a lot of writing in exercise books rather than practical maths work. She took extra tuition in high school to obtain a maths qualification in order to get to university and study a post-



graduate certificate in education (PGCE). John remembers standing in front of a chalkboard at school working out an equation in front of the class. He also remembers desks in a row and copying from the blackboard and writing in exercise books. John hired a tutor and re-took his maths qualification twice before he could study for his PGCE. Maria remembers working through text books, learning multiplication tables sitting at desks and learning in a rote fashion. Maria had no further maths education after gaining the required grade on her first attempt in order to attend university. Kate remembers teachers standing at the front of the class with her then writing answers in an exercise book. She also remembers being asked to answer maths problems in front of class and its damage to her confidence. At the time of interview Kate was having extra maths tuition as part of her newly qualified teacher (NQT) training in order to help her complete the maths requirement of the training.

Data generation and materials

Individual face-to-face semi- structured interviews were conducted using a schedule asking 12 open-ended questions plus prompts (see Appendix). Questions were designed to address a number of considerations. They built rapport with participants, enabling them to contemplate the topic under discussion and elaborate on aspects that held importance for them in relation to the overall focus of the research question. As the research question's aim is to uncover participants' experiences of maths anxiety the questions were open ended and framed to encourage participants to reflect on their childhood maths experiences, their adult and professional experiences and the type of maths support they may have received. The questions also enabled the interviewer to maintain control of the interview without leading the participant in particular directions (Willig, 2013). Each interview was held in a private room on school premises lasting 35 to 45 minutes and recorded using a Dictaphone. The material gathered from participants was transcribed verbatim.

Analytic procedure

Following the recommendations by Smith and colleagues (2003; 2009), IPA processes were applied to each transcript on a case-by-case basis. This was then followed by comparison across all the case transcripts.

Stage one

The interviews were read repeatedly to facilitate close interaction with the data followed by initial noting of exploratory comments. The exploratory comments consisted of descriptive, linguistic and interpretative comments. Descriptive comments involved identifying explanations and descriptions of events, emotional comments or key experiences described by the participants. Linguistic comments focused on the specific use of language that participants used to describe events and feelings. Linguistic features such as the use of metaphors, repetition, pauses, sighs or laughter were also noted. The third stage was interpretative and involved making conceptual comments about what the researcher believed was the participant's overarching understanding of what they were saying (Smith, Flowers, & Larkin, 2009). Table 2 outlines examples of the types of comments with the analysis found in the transcripts.

Table 2. Exploratory comments

| Type of Comment | Analysis of comments | Original Transcript |
|-----------------|--|--|
| Descriptive | Remembers the panic which heightened awareness of how children may feel when asked on the spot questions | "I just remember the panic part so it definitely makes me more aware of my kids" |
| Linguistic | Use of 'freak' expresses strength of reaction, use of 'definitely' reinforces action | "I would definitely have a bit of a freak out because I would have to go over things before I taught them" |



| | | |
|------------|---|--|
| Conceptual | Feels the advantage of having maths anxiety makes her a more effective teacher of maths | “I do think it has an advantage being aware I wasn’t good at maths.....I almost find it easier to teach maths because I feel I have a very simple way of doing it” |
|------------|---|--|

Stage 2

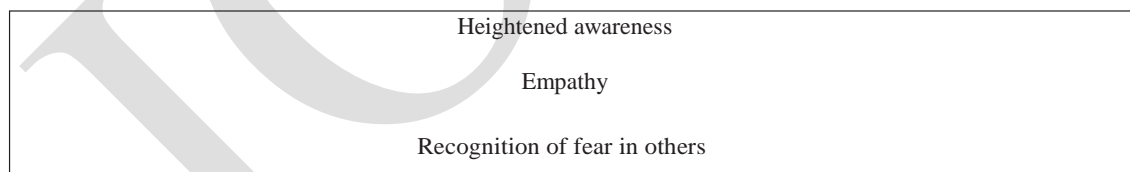
Initial themes that emerged from the exploratory analysis were identified by taking note of the transcript and the exploratory comments (Smith, Flowers, & Larkin, 2009). Themes were produced using a concise statement or phrase that captured and reflected the participant’s original words that alluded to their cognitive states, thoughts and feelings as well as the researcher’s interpretations (Table 3).

Table 3. Developing emergent themes

| Exploratory Comments | Transcript | Emergent themes |
|--|--|-------------------------------|
| Remembers the panic which heightened awareness of how children may feel when asked on the spot questions | “I just remember the panic part so it definitely makes me more aware of my kids” | Heightened awareness |
| Feels the advantage of having maths anxiety makes her a more effective teacher of maths | “I do think it has an advantage being aware I wasn’t good at math because when I explain maths to kids now, I almost find it easier to teach maths because I feel I have a very simple way of looking at it” | Empathy |
| Recognises panic in children | “If now if I have a kid that panics I can see and know they are going to panic” | Recognition of fear in others |

Stage 3

Superordinate themes were then developed by identifying connections between the emergent themes. Emerging themes were entered onto a list, printed and cut into separate pieces. The themes were moved around on a piece of card (670mm x940mm) into clusters that represented parallel or similar understandings and given a superordinate theme title that reflected the essence of the cluster (Box 1).



Box 1. Developing a superordinate theme

Stage 4

Once stages 1- 3 had been carried out on all transcripts, the final stage looked for patterns across all the cases to produce a master table of themes for the group. This involved laying out the individual themes for each participant typed in a different colour to ensure an even consideration of each participant. Each theme was cut into single items, placed on the card to facilitate identification of connections between the themes. As clusters of themes for the group were emerging the passages from each transcript were reread to ensure a close reflection of the data leading to the creation of new superordinate themes and sub themes along with extracts from the data to illustrate them. The superordinate themes were developed based on their perceived importance of the participant’s maths anxiety experiences. On completion, the final master table of



themes for the group emerged (Table 4). The quotes that it was felt most effectively reflected participants' thoughts and feelings about their maths anxiety were then analysed and are presented in the analysis section of this article.

FINDINGS

The three master themes and their subthemes (Table 4) that emerged from the analysis are presented with quotes from the participants and the researcher's interpretation of the analysis.

Table 4. Master themes for the group and their related sub-themes

| Superordinate Themes | Subordinate themes |
|---|---|
| Experiencing the psychological consequences of maths anxiety | Effects on learning and maths performance Effect on self-efficacy |
| Social influences | Parents and Teachers Peer relationships |
| The consequences of experiencing maths anxiety as a teaching professional | Recognition and understanding maths anxiety in pupils Benefits of experiencing maths anxiety |

Each superordinate theme and its related subordinate themes are presented and discussed individually.

Experiencing the psychological consequences of maths anxiety

Throughout their accounts, participants' experiences of maths were discussed as making them feel anxious and affecting their learning, maths performance and mathematical self-beliefs.

Effects on learning and maths performance

Participants reflected how their childhood classroom experiences contributed to their feelings of anxiety and how they made sense of the development of their maths anxiety.

'I hated maths, I really hated maths and being put on the spot I absolutely hated it (sigh, pause) You know when you are sat there and the teacher is going 'what is 5 x 7?' even if I knew it, I didn't know it when they asked me (pause) I remember just being so 'please don't ask me please don't ask me'. I just hated having to do something really quickly in front of people.' (Tania).

Tania's emphatic response, in which her strength of feeling was emphasised, reflected her tension, apprehension and worry at being singled out to answer a maths question in front of others. She focused on the apprehension of being selected to provide an answer rather than being able to think about the answer to the problem itself. Her constant fear of being singled out and being unable to answer questions appeared to reinforce her negative thoughts and feelings towards maths, thus setting up a situation of anxiety even around fairly straightforward numerical problems.

Maria recalled how her anxiety arose from the feelings of confusion she felt when attempting to learn new mathematical concepts but was unable to grasp the theories:

I do remember really hating it (pause) because it was just hard and fractions in particular. I didn't get it, they were just numbers and lines. People were giving me food and trying to talk to me about pizzas and cakes, way over my head and it stressed me out.

As with Tania, Maria emphasised her negative emotional response with reference to a specific issue – in her case 'fractions'. Even when people tried to illustrate them in everyday ways, such as with food, she became stressed as she struggled to understand these attempts at clarifying new concepts, thus linking to self-efficacy (Bandura, 1986).



Effect on self-efficacy

Self-efficacy is concerned with the extent to which an individual believes they are able to perform an activity (Bandura, 1986) and for these participants a shared negative self-belief in their maths ability was evident. For some, this judgment arose from a comparison of how good they believed they were at other subjects and the emotional attachment they attributed to them. Tania said:

I got an A in English because I loved it so much I think I would have been much more disappointed if I'd got low scores in anything like that I'm just really bad with numbers like I said before I don't remember numbers, no we're not friends.

Tania's emphasis that maths was not an area she was comfortable with, alongside her perception of her poor ability, was based on the comparison she made on her past performances in English. Her positive self-efficacy towards English, which she 'loved' was contrasted with her negative self-efficacy towards maths, which she 'hated'. Her rejection and dismissal of anything positive being linked to numbers appeared to reinforce her negative self-belief and led to her conclusion she was 'really bad' at maths.

Other participants demonstrated similar feelings of negative self-efficacy towards their maths ability, a stress that was perceived to have wider implications in terms of career choices. Maria said:

Before gaining newly qualified teaching status you have to do a maths multiple - choice. That was a bit stressful cause I'm like '(gasp) oh my gosh I don't know if I can even do it, how can I teach it?'

Maria's inward expression of doubt over her performance ability became apparent in her discussion of training to become a teacher. Her worry about having to complete the maths test influenced her perception of her ability to teach it. Similarly, Kate was concerned about the effects of her perceived lack of ability:

I just get worried that one day someone is going to ask me a question like subtract something and I'm going to be like 'umm ermm ' and just not be able to answer it which as a teacher you're expected to be like 'yep yep that's right'. Sometimes I feel like I'm not quick enough (pause) it's always been my weakest subject (pause) but I have actually not found that in the 7 weeks that I have been here.

Kate's internal conversation, suggesting the type of response she believed teachers are expected to give and what she believed would be her own response, again indicates negative self-efficacy towards maths ability. Her negative expectation suggested a belief that she was not good enough to teach maths even though that does not seem to have been found in practice.

Bandalos, Yates and Thorndike-Christ (1995) suggest that cues from past performance experiences can be factors that contribute to self-efficacy judgments. Some of the participants seemed to doubt their ability to teach maths based on previous negative experiences (McCulloch-Vinson, 2001). The lack of confidence is suggested by Klinger (2006) to be linked to negative mathematics self-efficacy beliefs that prevailed during school years. These are then carried on into adulthood and are supported by registering and recalling events that support this belief.

In addition to the psychological consequences of maths anxiety that were discussed in relation to their learning, maths performance and mathematical self- beliefs, participants also referred to the social influence of parents, teacher and peers.

Social influences

The second theme focuses on how the attitudes and behaviours of parents, teachers and peers affected participants' maths anxiety.



Parents and teachers

As a child, maths homework was a key activity for all the participants but, as Tania explained, this could become a problem:

I can remember taking maths homework home and obviously because my dad's a teacher and my mums a teacher I remember them trying to help me do it and I remember I'd get so frustrated I'd say 'no you don't understand that's not how we're doing it' (pause) it probably was how we were doing it but because I didn't understand it I remember having right strops about it.

Although Tania's parents were supportive in their attempts to help her with her homework, their problem-solving approaches were described as clashing with her teacher's instructions. This difference in approach appeared to leave her experiencing frustration and confusion which, in her own words, led to an angry reaction. In linking her frustration and anger to her lack of understanding of her maths homework, its difficulty became more apparent. Categorising her parents in terms of their occupation adds emphasis to her self-perception as someone who does not understand. Not all participants felt the same level of frustration, however. Maria, in contrast, felt encouraged and motivated by her mother's involvement:

My mum went and bought me books and I'd be like 'I don't get it' so yeah she'd buy me loads of stuff and be like 'this is how you do it'. It was good 'cause I liked working through books and getting stars and I liked the well done I liked that I remember my mum always saying 'ask someone if you don't know ask, ask what can you do, don't just sit there' I remember the stern talking to so I'm assuming that I asked.

Maria's memory of having the resources she needed and the pleasure she derived from being rewarded suggests she associated these positive events with her maths learning experience. The clear description of the memory of her mother demonstrating how to solve maths problems, and of the repetition and directive tone of her words of encouragement to Maria to actively ask questions suggests she was aware of the level of her mother's involvement and influence on her maths experience.

Participants also described clear memories of the pivotal part played by their teachers' attitudes and approaches in their maths anxiety experiences. Tania described how a teacher helped her reach a key goal in maths:

In fact, it was when I started not to hate it so much because I had a lot of tuition from my maths teacher at the time and erm (pause) I guess in a way it affected me in a good way, in the beginning you're scared of it, because I had to work really hard and I ended up getting a B and was so so chuffed (pause) because I was trying to just trying to get the C and I just worked hard.

Tania suggests that as her fear subsided, she began to feel less negative towards maths; although she still verbalised her negative feelings the teacher's support may have increased her motivation. Her hesitation as she speaks suggests her careful consideration of the effort required. Similarly, her recognition of the support she received suggests an understanding that the efforts of her teacher helped her reach her goal.

John experienced both positive and negative teacher attitudes and his contrasting accounts suggest this had an important influence on his approach to maths:

My middle school maths teacher, I had the same teacher all the way through I loved the guy he was fantastic and I remember, I don't remember many teachers names but I remember his (pause) he would actually talk to us like a proper human and he was a very very interesting guy and I think that maybe that made him more human.

John's use of emotive language alongside repetition alluded to the impact of his positive



experience with this particular teacher. The teacher's open and encouraging approach appeared to engage John's interest and he began to feel comfortable in the maths learning environment. He contrasted this experience with a different maths teacher whose attitude had a negative impact:

The teacher was very, erm (pause) she wasn't (pause) actually she wasn't very patient, she was very impatient (pause) you couldn't ask a question. I felt I couldn't ask a question without being shouted at.

John's hesitation in discussing how this teacher made him feel suggests his discomfort at remembering the teacher's impatient and aggressive approach that seemed to discourage student questions and created an intimidating environment. The negative cues John picked up from this teacher's behaviour may have highlighted maths in negative terms and possibly discouraged him from engaging in the learning experience for fear of being reprimanded.

Parental encouragement and expressing belief in a child's ability to learn may ensure they continue to try even when they find things difficult, something which is likely to lead to less maths anxious behaviour (Gunderson, Ramirez, Levine, & Beilock, 2012) and could increase mathematical resilience (Johnston-Wilder & Lee, 2010). Schofield (1981) concluded that teacher attitudes were directly linked to student attitude and performance in maths. In addition, as Das and Das (2013) suggested, teachers provided a guiding and leading role in the learning environment and were therefore highly influential in determining what happened in classrooms. Different experiences ensued from this complexity of interaction, though teachers who cultivated a positive learning environment encouraged children to learn and gain confidence. The opposite was true of negative teacher behaviour and attitudes, which discouraged children and created anxiety in them (Plaisance, 2009).

As well as the impact of their teachers the participants highlighted how their interactions with their peers also affected their maths anxiety.

Peer relationships

Peer relationships were important indicators to participants of how they compared themselves with their colleagues with regards to their concerns around maths.

'Once the Head gave us (a group of teachers) a SATS mental maths test cause she wanted us to see the pressure the kids were under. My first instinct was to see what the person next to me has written, you know like oh I'm right.' (Tania).

John describes his experience:

When I was doing my PGSE I realised I wasn't alone in my class of 30 people. There were guys who were phenomenal they were real mathematicians and it's when you start talking to your peers you realise 'you are actually in the same boat you're not so confident with it' and I could probably get to the same answer as they guy who got there in 30 seconds it might take me 2 minutes but I will get there.

John's personal attachment to his class suggests his feeling of connection to his peer group. His expression of admiration of colleagues whom he considered to be mathematicians indicates an acceptance of a range of maths skills. The 'same boat' metaphor suggests John's feelings of connection with others who experienced anxiety and reduced his feeling of isolation. Identifying with peers seemed to help John acknowledge his strengths rather than focusing on feeling less adequate. Being able to share experiences appeared to make him feel more comfortable in expressing his maths anxiety.

How individuals believed they were perceived by their peers appeared to be of concern throughout the interviews. For example, Maria said:

Sometimes when we are talking, when I'm with Tash and Gina, they are really



mathematicians, when I talk to them it all goes a bit over my head and I wouldn't ask (pause) I'd just be like 'yeah aha'. It's all about your relationship, (pause) Tash I'm a bit closer to and I would be like 'I didn't get it' whereas in front of Gina 'oh ok that's great' but have no idea.

Maria discussed how she modified her behaviour in front of her peers when discussing maths so that they did not perceive her to have less knowledge than them. This was particularly apparent in her description of her behaviour with different people and its link to how well she knew them. She seemed to gain some confidence from presenting an outwardly knowledgeable image when discussing maths, achieved by observing her colleagues' interactions and maintained her equal standing in that interaction by expressing agreement. In other cases, within the data, peer interaction was discussed as enhancing the ways in which participants viewed themselves. Kate said:

Coming straight from Uni your shown strategies for maths like multiplication grids (pause) they didn't know about that and I showed them the box method I was like 'who's seen that?' a few people had but some were like 'oh we've not seen that' so I was like 'yes one point to me'.

Kate outlined a maths discussion with peers where she introduced new mathematical tools that she had been introduced to while at university. This seemingly more knowledgeable status from someone who was lacking in experience seemed to give Kate a boost in confidence, enhancing her self-esteem. Her use of descriptive point scoring suggests that being able to demonstrate this greater knowledge made her feel as if she had an advantage over her peers, thus enhancing her self-image.

The awareness of the influence key people had on participants' maths anxiety was a common thread in their accounts. Research suggests that it is socially acceptable to express dislike for maths and to have anxiety around it without it affecting social perceptions of an individual's normal contribution to society or feeling socially compromised (Kindermann & Skinner, 2008), and this was certainly demonstrated by some participants. Others described comparisons with peers. Those who described more successful peers seemed to suffer from increased anxiety and stress, an effect seen in research where comparison to others may negatively affect self-esteem if an individual feels less able (Klinger, 2006). In other cases, however, successful comparisons can aid in self-evaluation (Wood, 1989), something demonstrated by participants in some circumstances. In addition to these comparisons, participants also discussed how experiencing maths anxiety was sometimes considered of benefit to them.

The consequences of experiencing maths anxiety as a teaching professional

In some of their discussions participants highlighted advantages of having a level of personal maths anxiety. In this theme we explore how experiencing maths anxiety was described as enabling participants to recognise similar feelings in their own pupils and how they believed it improved their maths teaching ability.

Recognition and understanding maths anxiety in pupils

Kate recognised behaviour in her pupils that she had exhibited as a child in maths lessons:

There are the ones that don't put their hands up probably like I used to do, that's when you get picked on because you've not put your hand up and then you get it wrong which knocks your confidence.

Kate related particular classroom behaviour to her own experience, interpreting not raising hands to answer questions as maths anxious behaviour: she reasoned that the children's fear of being selected made them anxious. Her use of 'picked on' suggests she felt empathy towards pupils exhibiting this behaviour. Recognition of anxiety and understanding its consequences enabled participants to employ teaching strategies that encouraged children to be less maths anxious. As Tania explained:



You can just tell straight away, I've got a little boy who just sits there and if there's a test or you are doing something or ask him something he doesn't know the answer, you can tell he is just going 'oh my God' and he just says numbers, random numbers and you think 'oh' and move onto someone else and then every time he does put his hand up I'll ask him because he knows and I'll give him a chance to say.

Tania's description of what she perceived the child may be thinking suggests she felt empathy for him within the classroom situation, which in turn enabled her to modify her own behaviour in order to reduce his anxiety levels. Awareness and recognition of maths anxious behaviour and understanding its impact on a child's learning meant participants were implementing positive teaching practices. Maria's example of positive teaching practice appeared also to be as a result of her awareness of her own maths anxiety experiences:

Now as a teacher I say 'when I was your age I didn't get this either so it's alright if you don't get it'. So I generate that sort of culture in the classroom.

Maria's expression of understanding demonstrates her expectation that some pupils would not understand some areas of maths. Her reflection on her own childhood experience seems to indicate why she was motivated to cultivate an inclusive classroom environment where it was socially acceptable to not understand maths immediately.

It has been suggested that teachers who fail to implement positive practices may actually cause students to learn maths anxious behaviours (McCulloch-Vinson, 2001). Subtle messages may unintentionally be given to children that can validate their opinion of being poor at maths; this, in turn may lower motivation and performance expectation. The participants' heightened awareness of maths anxiety and empathy, which they all perceived as a benefit, can help build confidence and encourage pupils to work harder to overcome maths difficulties (Beilock & Willingham, 2014).

Benefits of experiencing maths anxiety

Experiencing maths anxiety and having difficulties with it appeared to enhance Tania's teaching ability:

I do think it has an advantage being kind of aware that I wasn't good at maths or that I didn't really get maths because when I explain maths to kids now I almost find it easier to teach maths than I do English because I feel like I have a very simple way of looking at it.

Tania's observation that she found maths almost easier to teach than English suggests she understood the advantage of a simpler, more straightforward teaching approach, recognising the importance of being clear when delivering maths as a subject. Her own maths learning experience enhanced her awareness of the consequences of adopting a more flexible teaching approach towards. The participants also recognised, from their own experiences, that as teachers their attitudes were an important influence on children potentially developing maths anxiety. John highlighted:

I'm much more patient with them and er ok you don't understand it this way let's think of it another way so there's two, three or four ways that we try and get or I try and get the message across and er (slight pause) hand on heart I can honestly say if someone doesn't understand something I won't shout, you're not going to shout at a child because they don't understand and I think that is my biggest learn from my experience of maths being at school. You know I think, I think it's criminal to be impatient with a child with maths only from my point of view you know knowing how how I felt it's my job to then to try and think of different ways to make them understand.

John's use of affirmative language and his commitment to avoiding expressing irritation or impatience with children when they are learning suggests an awareness of his importance on the pupils' learning. His expression that this behaviour is "criminal" alludes to the strength of his belief



that intimidating behaviour is unacceptable and counterproductive.

Participants' approaches to teaching, based on their own experience, indicates the advantages that experiencing maths anxiety can bring to a maths teaching context. The role of the teacher in developing effective teaching methods breaks the cycle of maths anxiety that might otherwise continue (Beilock & Willingham, 2014). Being more attuned to recognising maths anxiety in their pupils, they felt they were better equipped to make adjustments to their teaching approach and instructional delivery.

DISCUSSION and CONCLUSION

The aim of this study was to explore the personal accounts of maths anxiety of primary school teachers using IPA, with the specific objectives of increasing understanding of its psychological impact by personal interaction with teachers and listening to their maths anxiety stories, their own reflections, perceptions and interpretations of their experiences. The key findings emerging from this study lend support to previous maths anxiety research whilst also contributing new aspects for future investigation.

This study helped uncover possible psychological consequences of maths anxiety with the use of IPA by highlighting details of participants' specific childhood maths situations. These were organised into three key themes: 'experiencing the psychological consequences of maths anxiety', 'social influences' and 'the consequences of experiencing maths anxiety as a teaching professional. Situations such as feelings of worry over being singled out and being 'picked on' to answer questions in front of others in class and being judged caused participants high levels of anxiety. Also, their anxiety interfered with their learning, particularly those aspects of maths perceived to be more difficult, such as fractions. The detailed information about past experiences and comparisons with performances in other areas also appeared to influence their self-efficacy judgement about not only their maths ability but also ability to teach it.

The detailed accounts connected to participants' social relationships and the impact these had on their maths anxiety mirrored other research findings that found positive support and encouragement from parents and teachers resulted in maths progression and increased confidence (Gunderson et al., 2012). However, if the social cues and observed behaviour particularly from teachers was deemed to be critical, aggressive and unsupportive this highlighted maths negatively, discouraged learning and resulted in increased anxiety (Schofield, 1981). Peer relationships helped participants feel less isolated and influenced aspects of their behaviour by either modifying it to 'fit in' socially or resulted in enhanced levels of self – esteem; social comparisons with peers influenced how participants viewed themselves in relation to how they interpreted their maths anxiety and ability within a social context (Klinger, 2006; Wood, 1989).

Finally, this study uncovered some potential consequences of experiencing maths anxiety as a teaching professional and offers some new insights. Previous research suggests in order to prevent maths anxiety developing, teachers need to adopt a variety of strategies: flexible teaching and testing methods, creating positive environments to help encourage positive self- concepts, encourage original thinking rather than learning by rote as well as being aware of teacher behaviours and the influence they can have on pupils (Plaisance, 2009). These recommendations mostly are based on findings from questionnaires with fixed choice responses whereas findings from this IPA study add further contributions to the literature by giving specific information direct from the participants' own experiences. In addition, the findings showed that teachers who have experienced maths anxiety believe it may be helpful in their teaching, echoing Trujillo and Hadfield's (1999) finding that maths anxious teacher wanted to be more understanding and progressive in their teaching. In our study teachers believed that their ability to identify and respond appropriately to maths anxious pupils was advantageous as it enabled them to further understand how their maths anxious pupils feel, readily recognise maths anxious behaviour, develop new teaching strategies to help



their pupils cope with maths anxiety and be more aware of the consequences of their own behaviour. Indeed, such a positive view of experiencing maths anxiety is associated with the concept of mathematical resilience, e.g. perseverance despite setbacks in maths (Johnston-Wilder & Lee, 2010); the findings presented here suggest mathematical resilience may be relevant to teachers as well as pupils, which can be further explored in future research. Future research could also investigate if these positive maths anxiety consequences are supported by use of measures of teacher effectiveness. This would have a huge impact on how and why we study maths anxiety in preservice and in-service teaching populations.

Limitations

The research reported here is one of only a few studies of maths anxiety taking a qualitative approach and is the first to use IPA to investigate maths anxiety amongst primary school teachers. The analysis of the data gives specific detail and a deeper understanding of primary school teachers' personal maths anxiety. However, some limitations should be considered. Participant teaching experience ranged from seven weeks to 10 years; more experienced participants may be more likely to have developed strategies for observing maths anxious behavior, not only due to their own maths anxiety experiences but also due to overall teaching experience of recognising children in difficulty. Heterogeneity of time spent teaching raises issues concerning disentangling attitudes and approaches based on teaching experience from those related to experiences pertaining to maths anxiety. This is particularly important given that length of teaching experience has been shown to be inversely related to maths teaching anxiety (Gresham, 2018; Hunt & Sari, 2019). Although gender differences in maths anxiety were not explored in this study, previous research into maths anxiety suggests females exhibit higher levels of maths anxiety than males (Devine, Fawcett, Szucs, & Dowker, 2012) therefore suggesting it is worth exploring this further across primary school teachers. Finally, the present study is confined to the specific context of UK culture; it is important to bear in mind the context-specific challenges faced by teachers globally, particularly in developing nations (Hunt, Simms, Cahoon, & Muwonge, 2021).

Conclusion

The findings from this study hold useful implications for understanding the influence of maths anxiety on teachers and teaching practices. Participants in this study perceived their own maths as beneficial, feeling it has helped them be more effective teachers. Highlighting the positive aspects of a phenomenon like maths anxiety, such as effective recognition of anxiety in pupils and using flexible teaching strategies to accommodate anxious pupils whilst still delivering the curriculum effectively, may help encourage a more mainstream approach to dealing with maths anxiety in the UK education system. This study also highlights the fact that teachers themselves experience maths anxiety and complements recent work on maths teaching anxiety (Hunt & Sari, 2019). Such awareness and recognition of the influence of teacher maths anxiety on its development in children could contribute to teacher training in the delivery of maths, as well as improved personal support to alleviate maths anxiety in teachers. Future research into teacher maths anxiety and whether it impacts teacher effectiveness may also provide new information that could highlight the benefits of experiencing maths anxiety rather than it being seen in a wholly negative light; indeed, such experiences may be associated with greater mathematics resilience. IPA is useful for exploring the self-reflective processes through which individuals interpret and understand their experiences (Brocki & Wearden, 2006). Therefore, continued use of IPA analysis in future studies may help with understanding the developmental trajectory of maths anxiety and its negative and positive impact on maths education. Overall, increasing awareness of the existence of maths anxiety in teachers is important for informing further research, interventions and training for student teachers as well as improving support and training for maths anxious qualified teachers, which may in turn impact the development of maths anxiety in the next generation of children.



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